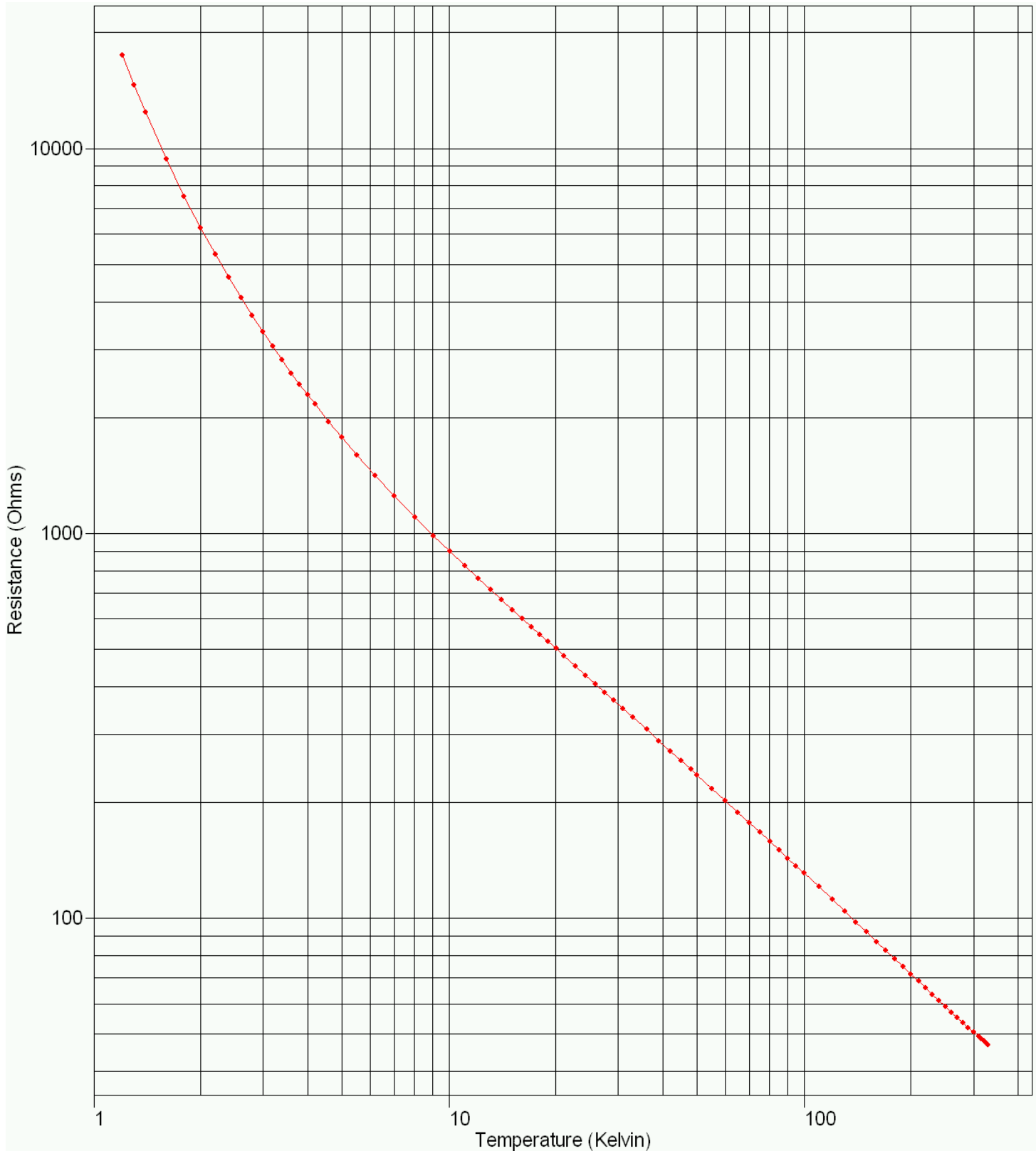


DATA PLOT

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K



TEST DATA

Calibration Report: 496809

Sensor Model: CX-1050-CU-1.4L

Sensor Type: Cernox Resistor

Sales Order: 32675

Serial Number: X42700

Temperature Range: 1.40K to 325K

Index	Temp. (K)	Resistance (Ω)	Excitation	Index	Temp. (K)	Resistance (Ω)	Excitation
1	1.20250	17491.6	2mV \pm 25%	46	42.0342	272.094	2mV \pm 25%
2	1.29910	14614.4	2mV \pm 25%	47	45.0366	256.863	2mV \pm 25%
3	1.39897	12413.3	2mV \pm 25%	48	48.0247	243.409	2mV \pm 25%
4	1.60273	9369.18	2mV \pm 25%	49	50.0326	235.210	2mV \pm 25%
5	1.79951	7508.56	2mV \pm 25%	50	55.0274	217.137	2mV \pm 25%
6	2.00236	6208.41	2mV \pm 25%	51	60.0273	201.847	2mV \pm 25%
7	2.20020	5300.90	2mV \pm 25%	52	65.0265	188.673	2mV \pm 25%
8	2.39938	4616.26	2mV \pm 25%	53	70.0288	177.234	2mV \pm 25%
9	2.59839	4089.80	2mV \pm 25%	54	75.0267	167.210	2mV \pm 25%
10	2.79577	3672.08	2mV \pm 25%	55	80.0234	158.296	2mV \pm 25%
11	2.99270	3335.94	2mV \pm 25%	56	85.0185	150.364	2mV \pm 25%
12	3.19051	3056.81	2mV \pm 25%	57	90.0161	143.221	2mV \pm 25%
13	3.39123	2819.73	2mV \pm 25%	58	95.0156	136.754	2mV \pm 25%
14	3.60425	2607.36	2mV \pm 25%	59	100.022	130.870	2mV \pm 25%
15	3.79880	2441.59	2mV \pm 25%	60	110.001	120.596	2mV \pm 25%
16	3.99838	2293.30	2mV \pm 25%	61	120.002	111.860	2mV \pm 25%
17	4.19678	2164.18	2mV \pm 25%	62	130.000	104.349	2mV \pm 25%
18	4.59394	1950.16	2mV \pm 25%	63	139.999	97.8238	2mV \pm 25%
19	4.99741	1774.69	2mV \pm 25%	64	149.998	92.0929	2mV \pm 25%
20	5.50514	1599.12	2mV \pm 25%	65	159.999	87.0233	2mV \pm 25%
21	6.21287	1410.86	2mV \pm 25%	66	170.004	82.5102	2mV \pm 25%
22	7.02207	1249.18	2mV \pm 25%	67	180.006	78.4668	2mV \pm 25%
23	8.03630	1098.38	2mV \pm 25%	68	190.001	74.8293	2mV \pm 25%
24	9.04483	985.131	2mV \pm 25%	69	200.011	71.5445	2mV \pm 25%
25	10.0555	895.968	2mV \pm 25%	70	210.021	68.5561	2mV \pm 25%
26	11.0722	823.510	2mV \pm 25%	71	220.022	65.8329	2mV \pm 25%
27	12.0824	763.782	2mV \pm 25%	72	230.019	63.3442	2mV \pm 25%
28	13.0901	713.531	2mV \pm 25%	73	240.030	61.0583	2mV \pm 25%
29	14.0936	670.550	2mV \pm 25%	74	250.023	58.9621	2mV \pm 25%
30	15.0868	633.486	2mV \pm 25%	75	260.033	57.0194	2mV \pm 25%
31	16.0806	600.876	2mV \pm 25%	76	270.038	55.2306	2mV \pm 25%
32	17.0700	571.952	2mV \pm 25%	77	280.043	53.5680	2mV \pm 25%
33	18.0575	546.066	2mV \pm 25%	78	290.050	52.0246	2mV \pm 25%
34	19.0463	522.686	2mV \pm 25%	79	300.064	50.5836	2mV \pm 25%
35	20.0341	501.469	2mV \pm 25%	80	310.081	49.2416	2mV \pm 25%
36	21.1236	480.167	2mV \pm 25%	81	315.093	48.6050	2mV \pm 25%
37	22.7180	452.376	2mV \pm 25%	82	320.098	47.9907	2mV \pm 25%
38	24.3026	428.070	2mV \pm 25%	83	326.099	47.2783	2mV \pm 25%
39	25.8994	406.286	2mV \pm 25%	84	330.103	46.8177	2mV \pm 25%
40	27.5145	386.584	2mV \pm 25%				
41	29.1272	368.890	2mV \pm 25%				
42	30.9375	350.995	2mV \pm 25%				
43	33.0518	332.305	2mV \pm 25%				
44	36.0528	309.194	2mV \pm 25%				
45	39.0529	289.304	2mV \pm 25%				



UNCERTAINTY ANALYSIS

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Calibration Data Uncertainty

The uncertainties of the measured calibration data for Lake Shore's sensors are summarized in the table below. The values given are the combined uncertainty of the temperature measurement and the resistance or voltage measurement expressed as an equivalent temperature uncertainty in millikelvin (mK). Note that the values are the calibration uncertainty only and do not include the stability of the temperature sensor. The uncertainty analysis has followed the guidelines for determining measurement uncertainty as outlined in the ISO Guide to the Expression of Uncertainty in Measurement, NIST Technical Note 1297, and ANSI/NCSL Z540-2-1997. Since the uncertainty varies with temperature due to the variation of the sensor sensitivity and excitation, the table gives typical values at several different temperatures throughout the range of the calibration. The uncertainty is based on an approximate 95% confidence level with a coverage factor $k = 2$.

T (K)	Uncertainty (+/- mK)											
	Ge (GR-200-X)		Cernox (CX-Y)		CGR	RX		Pt		RhFe		Diode
	X ≤ 100	X ≥ 250	Y ≤ 1030	Y ≥ 1050		-102	-103	100 Ω	25 Ω	27 Ω	100 Ω	
1.4	4	4	4	4	4	4	4			4	4	7
4.2	4	4	4	4	4	4	6			4	4	5
10	4	4	5	4	4	10	15			4	5	6
20	8	7	9	8	8	34	34	8	10	8	9	9
30	9	8	11	9	9	72	60	8	8	9	9	28
50	12	11	16	12	13			10	10	10	10	34
100	32	18	24	16	27			11	11	11	11	30
300			72	40	100			22	22	22	22	33
400			120	67				43	43	42		47
500								48	48			52

Polynomial Fit Uncertainty

When a sensor is used to measure temperature, a polynomial fit to the measured calibration data is often used to convert the sensor resistance (R) or voltage (V) to a temperature (T). How well the polynomial represents the sensor calibration data is another source of uncertainty when using the sensor. In the polynomials provided with this set of calibration data, the standard deviation of the fit can be used as an estimate of this additional temperature uncertainty. The standard deviation of fit is determined from the following equation:

$$\sigma_{fit}^2 = \frac{\sum_{i=1}^N (T_i - T_{icalc})^2}{N - n} = \frac{N}{N - n} (\Delta T_{RMS})^2$$

where σ_{fit} = standard deviation of the fit

T_i = measured temperature for point i

T_{icalc} = the temperature calculated from the polynomial equation for point i

N = number of data points in fit range

n = number of fit coefficients

ΔT_{RMS} = root mean square deviation of fit

A value of ΔT_{RMS} is given for each range of fit.

F008-04-00 (08/06/04)



POLYNOMIAL EQUATION

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

1.40K to 14.1K
1.238e+4 Ohms to 670.6 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.77878454807 ZU = 4.24282944306

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.563729	1.5342E-04	36263.88
1	-6.389606	2.4591E-04	-25983.88
2	2.784450	2.1574E-04	12906.45
3	-0.985941	2.2249E-04	-4431.36
4	0.285694	2.1188E-04	1348.36
5	-0.064061	1.9628E-04	-326.37
6	0.008764	1.9218E-04	45.60
7	0.000399	1.9171E-04	2.08
8	-0.001143	1.9468E-04	-5.87

$Z = \text{Log}(\text{resistance})$

$X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)$

Temp. (K) = $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$, where $0 \leq i \leq 8$
and the A_i 's are the coefficients in the table above.



POLYNOMIAL EQUATION

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	17491.60	1.20250	1.20229	0.21
2	14614.41	1.29910	1.29991	-0.81
3	12413.33	1.39897	1.39831	0.66
4	9369.176	1.60273	1.60214	0.59
5	7508.558	1.79951	1.80015	-0.63
6	6208.406	2.00236	2.00306	-0.70
7	5300.903	2.20020	2.20038	-0.18
8	4616.256	2.39938	2.39919	0.18
9	4089.805	2.59839	2.59724	1.15
10	3672.081	2.79577	2.79552	0.26
11	3335.943	2.99270	2.99239	0.31
12	3056.814	3.19051	3.19041	0.10
13	2819.733	3.39123	3.39132	-0.09
14	2607.357	3.60425	3.60465	-0.40
15	2441.593	3.79880	3.79915	-0.35
16	2293.295	3.99838	3.99927	-0.89
17	2164.181	4.19678	4.19818	-1.40
18	1950.155	4.59394	4.59294	1.00
19	1774.693	4.99741	4.99725	0.17
20	1599.123	5.50514	5.50417	0.97
21	1410.862	6.21287	6.21202	0.85
22	1249.180	7.02207	7.02236	-0.29
23	1098.376	8.03630	8.03677	-0.48
24	985.1309	9.04483	9.04527	-0.44
25	895.9677	10.05549	10.05601	-0.52
26	823.5105	11.07217	11.07160	0.56
27	763.7818	12.08236	12.08262	-0.26
28	713.5311	13.09008	13.08965	0.43
29	670.5504	14.09355	14.09306	0.49
30	633.4856	15.08683	15.08724	-0.42
31	600.8756	16.08062	16.08070	-0.08

Order of Fit = 8 RMS error of fit = 0.61 mK
Largest absolute error = -1.40 mK at data point no. 17



POLYNOMIAL EQUATION

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

14.1K to 80.0K
670.6 Ohms to 158.3 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.15600582968 ZU = 2.88296931429

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	41.973167	4.6381E-04	90495.94
1	-37.600205	7.5543E-04	-49773.41
2	8.908791	6.9258E-04	12863.13
3	-1.355559	6.4320E-04	-2107.52
4	0.171244	6.1876E-04	276.75
5	-0.011397	5.9415E-04	-19.18
6	-0.004602	5.8831E-04	-7.82
7	0.000478	5.7175E-04	0.84
8	0.000758	5.7291E-04	1.32

$Z = \text{Log}(\text{resistance})$

$X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)$

Temp. (K) = $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$, where $0 \leq i \leq 8$
and the A_i 's are the coefficients in the table above.



POLYNOMIAL EQUATION

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
27	763.7818	12.08262	12.08268	-0.06
28	713.5311	13.08965	13.08940	0.26
29	670.5504	14.09306	14.09323	-0.16
30	633.4856	15.08683	15.08735	-0.52
31	600.8756	16.08062	16.08002	0.60
32	571.9519	17.07001	17.06993	0.08
33	546.0660	18.05750	18.05794	-0.44
34	522.6864	19.04633	19.04622	0.11
35	501.4691	20.03412	20.03349	0.63
36	480.1673	21.12357	21.12356	0.01
37	452.3761	22.71804	22.71863	-0.60
38	428.0699	24.30261	24.30259	0.02
39	406.2859	25.89942	25.90006	-0.65
40	386.5841	27.51451	27.51511	-0.60
41	368.8904	29.12719	29.12626	0.93
42	350.9952	30.93753	30.93583	1.70
43	332.3052	33.05184	33.05207	-0.23
44	309.1944	36.05279	36.05351	-0.72
45	289.3041	39.05287	39.05402	-1.15
46	272.0944	42.03425	42.03487	-0.62
47	256.8629	45.03663	45.03537	1.26
48	243.4089	48.02465	48.02547	-0.81
49	235.2103	50.03262	50.02988	2.74
50	217.1370	55.02737	55.03074	-3.37
51	201.8467	60.02729	60.02332	3.97
52	188.6734	65.02651	65.02974	-3.24
53	177.2343	70.02884	70.03091	-2.08
54	167.2097	75.02671	75.02059	6.12
55	158.2964	80.02344	80.02745	-4.01
56	150.3639	85.01855	85.01777	0.78
57	143.2207	90.01610	90.01604	0.06

Order of Fit = 8 RMS error of fit = 1.92 mK
Largest absolute error = 6.12 mK at data point no. 54



POLYNOMIAL EQUATION

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

80.0K to 325.K
158.3 Ohms to 47.41 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.67040995729 ZU = 2.24854772691

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	175.192716	1.3838E-03	126599.90
1	-126.032426	2.1526E-03	-58548.22
2	24.066336	2.0402E-03	11795.91
3	-3.830057	1.9246E-03	-1990.04
4	0.778139	1.8329E-03	424.55
5	-0.167972	1.8467E-03	-90.96
6	0.028254	1.8181E-03	15.54
7	-0.007433	1.7770E-03	-4.18
8	0.003442	1.7689E-03	1.95

$Z = \text{Log}(\text{resistance})$

$X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)$

Temp. (K) = $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$, where $0 \leq i \leq 8$
and the A_i 's are the coefficients in the table above.



POLYNOMIAL EQUATION

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
53	177.2343	70.03091	70.03100	-0.09
54	167.2097	75.02059	75.02018	0.41
55	158.2964	80.02745	80.02819	-0.74
56	150.3639	85.01855	85.01828	0.27
57	143.2207	90.01610	90.01499	1.11
58	136.7537	95.01558	95.01670	-1.12
59	130.8699	100.02157	100.02211	-0.55
60	120.5959	110.00120	109.99997	1.23
61	111.8600	120.00174	120.00130	0.45
62	104.3491	129.99963	130.00298	-3.34
63	97.82378	139.99893	139.99627	2.66
64	92.09288	149.99837	149.99707	1.31
65	87.02333	159.99934	160.00003	-0.69
66	82.51018	170.00438	170.00232	2.06
67	78.46680	180.00636	180.00978	-3.41
68	74.82927	190.00138	190.01268	-11.30
69	71.54455	200.01117	200.00191	9.27
70	68.55610	210.02090	210.01140	9.49
71	65.83293	220.02179	220.02017	1.61
72	63.34417	230.01852	230.02290	-4.37
73	61.05833	240.02991	240.03775	-7.84
74	58.96215	250.02306	250.01901	4.05
75	57.01943	260.03302	260.04611	-13.09
76	55.23063	270.03766	270.02906	8.60
77	53.56801	280.04332	280.03797	5.35
78	52.02463	290.05049	290.03934	11.15
79	50.58356	300.06362	300.07222	-8.61
80	49.24162	310.08102	310.09169	-10.67
81	48.60496	315.09288	315.09597	-3.09
82	47.99068	320.09784	320.08911	8.74
83	47.27833	326.09887	326.09411	4.76
84	46.81769	330.10316	330.10678	-3.61

Order of Fit = 8 RMS error of fit = 6.00 mK
Largest absolute error = -13.09 mK at data point no. 75



INTERPOLATION TABLE

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
1.400	12380.6	-19285.	-2.1807	15.50	619.446	-33.158	-0.82968
1.500	10696.5	-14692.	-2.0603	16.00	603.361	-31.212	-0.82768
1.600	9393.89	-11558.	-1.9685	16.50	588.204	-29.445	-0.82597
1.700	8354.97	-9328.5	-1.8981	17.00	573.891	-27.833	-0.82448
1.800	7509.67	-7656.6	-1.8352	17.50	560.348	-26.360	-0.82323
1.900	6810.61	-6377.7	-1.7792	18.00	547.511	-25.008	-0.82216
2.000	6224.83	-5378.6	-1.7281	18.50	535.322	-23.765	-0.82129
2.100	5727.99	-4586.7	-1.6816	19.00	523.730	-22.619	-0.82057
2.200	5302.40	-3947.9	-1.6380	19.50	512.688	-21.559	-0.82001
2.300	4934.48	-3427.5	-1.5976	20.00	502.157	-20.578	-0.81957
2.400	4613.84	-2999.0	-1.5600	21.00	482.480	-18.818	-0.81908
2.500	4332.26	-2643.0	-1.5252	22.00	464.443	-17.289	-0.81897
2.600	4083.32	-2344.5	-1.4928	23.00	447.838	-15.951	-0.81921
2.700	3861.83	-2092.1	-1.4627	24.00	432.489	-14.770	-0.81966
2.800	3663.64	-1877.2	-1.4347	25.00	418.252	-13.724	-0.82033
2.900	3485.36	-1692.9	-1.4086	26.00	405.003	-12.791	-0.82113
3.000	3324.23	-1533.8	-1.3842	27.00	392.638	-11.954	-0.82202
3.100	3177.92	-1395.5	-1.3613	28.00	381.067	-11.201	-0.82299
3.200	3044.54	-1274.8	-1.3399	29.00	370.213	-10.519	-0.82397
3.300	2922.47	-1168.8	-1.3197	30.00	360.009	-9.9001	-0.82499
3.400	2810.37	-1075.2	-1.3008	31.00	350.395	-9.3362	-0.82599
3.500	2707.07	-992.25	-1.2829	32.00	341.320	-8.8207	-0.82697
3.600	2611.61	-918.38	-1.2659	33.00	332.739	-8.3481	-0.82794
3.700	2523.14	-852.37	-1.2499	34.00	324.611	-7.9136	-0.82888
3.800	2440.92	-793.13	-1.2347	35.00	316.901	-7.5125	-0.82971
3.900	2364.31	-739.78	-1.2203	36.00	309.576	-7.1422	-0.83056
4.000	2292.79	-691.57	-1.2065	37.00	302.607	-6.7995	-0.83138
4.200	2163.07	-608.24	-1.1810	38.00	295.969	-6.4810	-0.83211
4.400	2048.56	-538.94	-1.1576	39.00	289.638	-6.1850	-0.83282
4.600	1946.75	-480.83	-1.1362	40.00	283.592	-5.9093	-0.83350
4.800	1855.64	-431.64	-1.1165	42.00	272.283	-5.4112	-0.83469
5.000	1773.62	-389.63	-1.0984	44.00	261.906	-4.9747	-0.83575
5.200	1699.39	-353.48	-1.0816	46.00	252.349	-4.5901	-0.83671
5.400	1631.91	-322.14	-1.0660	48.00	243.517	-4.2490	-0.83753
5.600	1570.26	-294.93	-1.0518	50.00	235.328	-3.9457	-0.83834
5.800	1513.72	-270.96	-1.0382	52.00	227.713	-3.6743	-0.83905
6.000	1461.69	-249.81	-1.0254	54.00	220.613	-3.4304	-0.83967
6.500	1348.02	-206.94	-0.99783	56.00	213.975	-3.2111	-0.84039
7.000	1253.06	-174.35	-0.97400	58.00	207.755	-3.0125	-0.84100
7.500	1172.44	-149.10	-0.95375	60.00	201.913	-2.8323	-0.84165
8.000	1103.10	-129.07	-0.93602	65.00	188.746	-2.4487	-0.84328
8.500	1042.72	-112.99	-0.92108	70.00	177.300	-2.1404	-0.84505
9.000	989.625	-99.815	-0.90775	75.00	167.249	-1.8884	-0.84683
9.500	942.520	-88.924	-0.89630	77.35	162.933	-1.7856	-0.84768
10.00	900.410	-79.783	-0.88607	80.00	158.344	-1.6800	-0.84880
10.50	862.500	-72.060	-0.87725	85.00	150.391	-1.5059	-0.85110
11.00	828.166	-65.448	-0.86931	90.00	143.241	-1.3582	-0.85336
11.50	796.896	-59.762	-0.86243	95.00	136.774	-1.2317	-0.85553
12.00	768.280	-54.820	-0.85625	100.0	130.895	-1.1227	-0.85772
12.50	741.971	-50.505	-0.85086	105.0	125.523	-1.0279	-0.85984
13.00	717.690	-46.701	-0.84593	110.0	120.596	-0.94501	-0.86198
13.50	695.196	-43.339	-0.84161	115.0	116.057	-0.87209	-0.86415
14.00	674.288	-40.352	-0.83780	120.0	111.861	-0.80750	-0.86625
14.50	654.790	-37.690	-0.83462	125.0	107.970	-0.74999	-0.86829
15.00	636.552	-35.304	-0.83191	130.0	104.351	-0.69851	-0.87020



INTERPOLATION TABLE

Calibration Report: 496809
Sensor Model: CX-1050-CU-1.4L
Sensor Type: Cernox Resistor

Sales Order: 32675
Serial Number: X42700
Temperature Range: 1.40K to 325K

<u>Temp (K)</u>	<u>Res. (Ω)</u>	<u>dR/dT (Ω/K)</u>	<u>dlogR/dlogT</u>	<u>Temp (K)</u>	<u>Res. (Ω)</u>	<u>dR/dT (Ω/K)</u>	<u>dlogR/dlogT</u>
135.0	100.976	-0.65222	-0.87199	235.0	62.1839	-0.22821	-0.86242
140.0	97.8215	-0.61039	-0.87358	240.0	61.0666	-0.21883	-0.86002
145.0	94.8659	-0.57246	-0.87498	245.0	59.9948	-0.20998	-0.85749
150.0	92.0913	-0.53791	-0.87616	250.0	58.9660	-0.20162	-0.85483
155.0	89.4818	-0.50636	-0.87711	255.0	57.9778	-0.19373	-0.85205
160.0	87.0233	-0.47744	-0.87781	260.0	57.0280	-0.18625	-0.84916
165.0	84.7035	-0.45087	-0.87828	265.0	56.1146	-0.17918	-0.84616
170.0	82.5112	-0.42639	-0.87850	270.0	55.2356	-0.17247	-0.84305
175.0	80.4365	-0.40378	-0.87848	273.15	54.6988	-0.16842	-0.84104
180.0	78.4705	-0.38286	-0.87823	275.0	54.3894	-0.16610	-0.83984
185.0	76.6053	-0.36346	-0.87775	280.0	53.5741	-0.16006	-0.83653
190.0	74.8336	-0.34544	-0.87705	285.0	52.7883	-0.15431	-0.83313
195.0	73.1489	-0.32866	-0.87614	290.0	52.0305	-0.14885	-0.82964
200.0	71.5451	-0.31302	-0.87503	295.0	51.2993	-0.14365	-0.82606
205.0	70.0169	-0.29842	-0.87374	300.0	50.5936	-0.13870	-0.82241
210.0	68.5593	-0.28477	-0.87226	305.0	49.9120	-0.13397	-0.81868
215.0	67.1678	-0.27198	-0.87060	310.0	49.2535	-0.12947	-0.81487
220.0	65.8382	-0.26000	-0.86879	315.0	48.6170	-0.12517	-0.81100
225.0	64.5666	-0.24874	-0.86681	320.0	48.0015	-0.12106	-0.80706
230.0	63.3496	-0.23816	-0.86469	325.0	47.4060	-0.11714	-0.80307



THERMAL CYCLE TESTING

Sensor Model: CX-1050-CU-1.4L

Serial Number: X42700

Sensor Type: Cernox Resistor

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead resistance values were recorded:

Room Temperature:	49.9 Ω
Liquid Nitrogen:	163 Ω
Liquid Helium:	2160 Ω

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other dip test values should not be made.

Recommended Operating Parameters:

For sensors calibrated by LSCI the current to the sensor is adjusted to maintain the sensor output voltage or power at the values listed on the Test Data page. In order to minimize possible self-heating errors, we suggest that these same guidelines be followed in using the sensor.

Lead Identification:

Blue:	I+
Red:	I-
Clear:	V+
Green:	V-

To avoid possible damage to the sensor, do not exceed 1 Volt and do not exceed 100 mA current.



BREAKPOINTS 340 FORMAT

Calibration Report: 496809

Sensor Model: CX-1050-CU-1.4L

Sensor Type: Cernox Resistor

Sales Order: 32675

Serial Number: X42700

Temperature Range: 1.40K to 325K

Name: CX-1050-CU-1.4L

Serial number: X42700

Format: 4 ;Log Ohms/Kelvin

Limit: 325.0

Coefficient: 1 ;Negative

Point 1: 1.67582,325.000	Point 56: 2.19047, 82.000	Point 111: 2.95245, 10.050
Point 2: 1.68234,319.000	Point 57: 2.20189, 79.500	Point 112: 2.97014, 9.600
Point 3: 1.68846,313.500	Point 58: 2.21129, 77.500	Point 113: 2.98888, 9.150
Point 4: 1.69472,308.000	Point 59: 2.22090, 75.500	Point 114: 3.00655, 8.750
Point 5: 1.70112,302.500	Point 60: 2.23077, 73.500	Point 115: 3.02522, 8.350
Point 6: 1.70768,297.000	Point 61: 2.24091, 71.500	Point 116: 3.04507, 7.950
Point 7: 1.71439,291.500	Point 62: 2.25132, 69.500	Point 117: 3.06623, 7.550
Point 8: 1.72126,286.000	Point 63: 2.26203, 67.500	Point 118: 3.08603, 7.200
Point 9: 1.72829,280.500	Point 64: 2.27305, 65.500	Point 119: 3.10706, 6.850
Point 10: 1.73484,275.500	Point 65: 2.28440, 63.500	Point 120: 3.12958, 6.500
Point 11: 1.74153,270.500	Point 66: 2.29611, 61.500	Point 121: 3.15377, 6.150
Point 12: 1.74837,265.500	Point 67: 2.30881, 59.400	Point 122: 3.17835, 5.820
Point 13: 1.75537,260.500	Point 68: 2.32005, 57.600	Point 123: 3.20407, 5.500
Point 14: 1.76252,255.500	Point 69: 2.33164, 55.800	Point 124: 3.23014, 5.200
Point 15: 1.76985,250.500	Point 70: 2.34360, 54.000	Point 125: 3.25834, 4.900
Point 16: 1.77734,245.500	Point 71: 2.35596, 52.200	Point 126: 3.28699, 4.620
Point 17: 1.78501,240.500	Point 72: 2.36874, 50.400	Point 127: 3.31814, 4.340
Point 18: 1.79287,235.500	Point 73: 2.38197, 48.600	Point 128: 3.34982, 4.080
Point 19: 1.80091,230.500	Point 74: 2.39570, 46.800	Point 129: 3.37631, 3.880
Point 20: 1.80916,225.500	Point 75: 2.40835, 45.200	Point 130: 3.40180, 3.700
Point 21: 1.81761,220.500	Point 76: 2.42142, 43.600	Point 131: 3.42762, 3.530
Point 22: 1.82627,215.500	Point 77: 2.43498, 42.000	Point 132: 3.45530, 3.360
Point 23: 1.83515,210.500	Point 78: 2.44905, 40.400	Point 133: 3.48337, 3.200
Point 24: 1.84426,205.500	Point 79: 2.46274, 38.900	Point 134: 3.51356, 3.040
Point 25: 1.85361,200.500	Point 80: 2.47695, 37.400	Point 135: 3.54419, 2.890
Point 26: 1.86321,195.500	Point 81: 2.49172, 35.900	Point 136: 3.57726, 2.740
Point 27: 1.87208,191.000	Point 82: 2.50710, 34.400	Point 137: 3.61081, 2.600
Point 28: 1.88116,186.500	Point 83: 2.52206, 33.000	Point 138: 3.64719, 2.460
Point 29: 1.89048,182.000	Point 84: 2.53763, 31.600	Point 139: 3.68696, 2.320
Point 30: 1.90002,177.500	Point 85: 2.55388, 30.200	Point 140: 3.72744, 2.190
Point 31: 1.90982,173.000	Point 86: 2.56964, 28.900	Point 141: 3.77177, 2.060
Point 32: 1.91987,168.500	Point 87: 2.58608, 27.600	Point 142: 3.81687, 1.940
Point 33: 1.93020,164.000	Point 88: 2.60330, 26.300	Point 143: 3.86643, 1.820
Point 34: 1.94081,159.500	Point 89: 2.62137, 25.000	Point 144: 3.92147, 1.700
Point 35: 1.95171,155.000	Point 90: 2.63889, 23.800	Point 145: 3.97777, 1.590
Point 36: 1.96293,150.500	Point 91: 2.65729, 22.600	Point 146: 4.03474, 1.490
Point 37: 1.97447,146.000	Point 92: 2.67668, 21.400	Point 147: 4.09226, 1.400
Point 38: 1.98636,141.500	Point 93: 2.69547, 20.300	
Point 39: 1.99725,137.500	Point 94: 2.70982, 19.500	
Point 40: 2.00843,133.500	Point 95: 2.72190, 18.850	
Point 41: 2.01993,129.500	Point 96: 2.73441, 18.200	
Point 42: 2.03177,125.500	Point 97: 2.74740, 17.550	
Point 43: 2.04398,121.500	Point 98: 2.75985, 16.950	
Point 44: 2.05657,117.500	Point 99: 2.77277, 16.350	
Point 45: 2.06956,113.500	Point 100: 2.78620, 15.750	
Point 46: 2.08300,109.500	Point 101: 2.80019, 15.150	
Point 47: 2.09516,106.000	Point 102: 2.81357, 14.600	
Point 48: 2.10769,102.500	Point 103: 2.82750, 14.050	
Point 49: 2.11877, 99.500	Point 104: 2.84206, 13.500	
Point 50: 2.12825, 97.000	Point 105: 2.85730, 12.950	
Point 51: 2.13795, 94.500	Point 106: 2.87182, 12.450	
Point 52: 2.14790, 92.000	Point 107: 2.88702, 11.950	
Point 53: 2.15811, 89.500	Point 108: 2.90297, 11.450	
Point 54: 2.16860, 87.000	Point 109: 2.91977, 10.950	
Point 55: 2.17938, 84.500	Point 110: 2.93570, 10.500	



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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 496809

Sales Order: 32675

Sensor Model: CX-1050-CU-1.4L

Serial Number: X42700

Sensor Type: Cernox Resistor

Temperature Range: 1.40K to 325K

Interpolation Method: Lagrangian

Limit: 325.0 (Kelvin)

Format: 4 (Log Ohms/Kelvin)

Number of Breakpoints: 54

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.67583	325.0	31	2.84483	13.4
2	1.67691	324.0	32	2.90140	11.5
3	1.68791	314.0	33	2.95831	9.9
4	1.70529	299.0	34	3.01350	8.6
5	1.72381	284.0	35	3.06909	7.5
6	1.74358	269.0	36	3.12310	6.6
7	1.76472	254.0	37	3.18005	5.8
8	1.78736	239.0	38	3.23029	5.2
9	1.81169	224.0	39	3.28931	4.6
10	1.83788	209.0	40	3.34750	4.1
11	1.86616	194.0	41	3.40194	3.7
12	1.89683	179.0	42	3.44876	3.4
13	1.93022	164.0	43	3.50214	3.1
14	1.96676	149.0	44	3.54225	2.9
15	2.00703	134.0	45	3.58679	2.7
16	2.05183	119.0	46	3.63671	2.5
17	2.10230	104.0	47	3.69324	2.3
18	2.16021	89.0	48	3.72447	2.2
19	2.22830	74.0	49	3.79413	2.0
20	2.29317	62.0	50	3.83319	1.9
21	2.33036	56.0	51	3.87562	1.8
22	2.37167	50.0	52	3.92194	1.7
23	2.40999	45.0	53	4.02924	1.5
24	2.45269	40.0	54	4.09274	1.4
25	2.50092	35.0			
26	2.55631	30.0			
27	2.61578	25.4			
28	2.67346	21.6			
29	2.73055	18.4			
30	2.78739	15.7			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	136.509
1000	8.897
10000	1.550



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BREAKPOINTS 234 FORMAT

Calibration Report: 496809

Sensor Model: CX-1050-CU-1.4L

Sensor Type: Cernox Resistor

Sales Order: 32675

Serial Number: X42700

Temperature Range: 1.40K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.011K
10 - 20K:	0.005K
20 - 40K:	0.008K
40 - 100K:	0.021K
> 100K:	0.096K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	321.150	47.86301	1.680	51	21.206	478.6301	2.680
2	303.462	50.11872	1.700	52	20.047	501.1872	2.700
3	287.009	52.48075	1.720	53	18.952	524.8075	2.720
4	271.644	54.95409	1.740	54	17.919	549.5409	2.740
5	257.257	57.54399	1.760	55	16.945	575.4399	2.760
6	243.764	60.25596	1.780	56	16.026	602.5596	2.780
7	231.070	63.09573	1.800	57	15.160	630.9573	2.800
8	219.114	66.06934	1.820	58	14.345	660.6934	2.820
9	207.833	69.18310	1.840	59	13.578	691.8310	2.840
10	197.169	72.44360	1.860	60	12.857	724.4360	2.860
11	187.076	75.85776	1.880	61	12.180	758.5776	2.880
12	177.521	79.43282	1.900	62	11.543	794.3282	2.900
13	168.453	83.17638	1.920	63	10.945	831.7638	2.920
14	159.847	87.09636	1.940	64	10.384	870.9636	2.940
15	151.672	91.20108	1.960	65	9.857	912.0108	2.960
16	143.902	95.49926	1.980	66	9.362	954.9926	2.980
17	136.512	100.0000	2.000	67	8.897	1000.000	3.000
18	129.484	104.7129	2.020	68	8.052	1096.478	3.040
19	122.798	109.6478	2.040	69	7.306	1202.264	3.080
20	116.440	114.8154	2.060	70	6.648	1318.257	3.120
21	110.392	120.2264	2.080	71	6.066	1445.440	3.160
22	104.642	125.8925	2.100	72	5.551	1584.893	3.200
23	99.177	131.8257	2.120	73	5.094	1737.801	3.240
24	93.983	138.0384	2.140	74	4.688	1905.461	3.280
25	89.050	144.5440	2.160	75	4.326	2089.296	3.320
26	84.363	151.3561	2.180	76	4.003	2290.868	3.360
27	79.913	158.4893	2.200	77	3.713	2511.886	3.400
28	75.689	165.9587	2.220	78	3.453	2754.229	3.440
29	71.682	173.7801	2.240	79	3.219	3019.952	3.480
30	67.876	181.9701	2.260	80	3.008	3311.311	3.520
31	64.273	190.5461	2.280	81	2.818	3630.781	3.560
32	60.854	199.5262	2.300	82	2.645	3981.072	3.600
33	57.612	208.9296	2.320	83	2.488	4365.158	3.640
34	54.540	218.7762	2.340	84	2.344	4786.301	3.680
35	51.630	229.0868	2.360	85	2.214	5248.075	3.720
36	48.869	239.8833	2.380	86	2.094	5754.399	3.760
37	46.254	251.1886	2.400	87	1.984	6309.573	3.800
38	43.776	263.0268	2.420	88	1.883	6918.310	3.840
39	41.427	275.4229	2.440	89	1.790	7585.776	3.880
40	39.200	288.4032	2.460	90	1.704	8317.638	3.920
41	37.090	301.9952	2.480	91	1.624	9120.108	3.960
42	35.090	316.2278	2.500	92	1.551	10000.00	4.000
43	33.194	331.1311	2.520	93	1.389	12589.25	4.100
44	31.396	346.7369	2.540	94	1.254	15848.93	4.200
45	29.693	363.0781	2.560				
46	28.079	380.1894	2.580				
47	26.549	398.1072	2.600				
48	25.101	416.8694	2.620				
49	23.730	436.5158	2.640				
50	22.433	457.0882	2.660				



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